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Department of Defence

Visits by Nuclear Powered Warships to Australian Ports

Report on Radiation Monitoring during 1986

Canberra Australia

January 1988

APPROVED

FOR PUBLIC RELEASE

VISITS BY

NUCLEAR POWERED WARSHIPS

TO AUSTRALIAN PORTS

Report on Radiation Monitoring During 1986

and

Radiation Monitoring at Australian Ports
Visited by Nuclear Powered Warships
- Requirements, Arrangements and Procedures

Department of Defence
Canberra, Australia
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CONTENTS

SUMMARY

Nuclear powered warships (NPWs) of the United States Navy visited Australia on five occasions during 1986. The Commonwealth Government requires that a radiation monitoring program be carried out in association with such visits to detect any release of radioactivity to the port or its environs.

This report represents a summary of the objectives and requirements of the NPW radiation monitoring program, describes the implementation of the program for visits during 1986 and records the results of radiation measurements taken in the ports visited.

No releases of radioactive material were detected, nor were any radiation measurements recorded in excess of background levels of ionising radiation either during or subsequent to these visits.

PART I - GENERAL

INTRODUCTION

1. Nuclear Powered Warships (NPWs) of the United States Navy visited Australia on five occasions during 1986, as recorded at Table 1. The Commonwealth Government requires that a radiation monitoring program be carried out in association with such visits to detect any release of radioactivity to the port or its environs or any increase in external radiation levels above that due to natural background.

2. This report presents a summary of the objectives and requirements of the NPW radiation monitoring program, describes the implementation of the program for visits during 1986 and records the results of radiation measurement taken.

THE RADIATION MONITORING PROGRAM

3. The requirements for the monitoring program are laid down in **Radiation Monitoring at Australian Ports Visited by Nuclear Powered Warships - Requirements, Arrangements and Procedures** - Department of Defence, November 1986. These requirements were originally published in **Report and Guidelines on Environmental Radiation Monitoring During Visits to Australian Ports by Nuclear Powered Warships** - Department of Science and Environment - September 1979, and the Amendment was published in **Visits by Nuclear Powered Warships to Australian Ports - Report on Environmental Radiation Monitoring During 1980 and Amendments to Radiation Monitoring Guidelines** - Department of Home Affairs and Environment - April 1981. The revised document is at Appendix II to this report.

4. The monitoring program has two main components:

a. environmental monitoring, designed to detect the release of any radioactive material (eg waste) to the environment; and

b. direct radiation monitoring, designed to provide warning of any malfunction of the reactor of an NPW whilst in port which might lead to a release of radioactivity.

Environmental Monitoring

5. The environmental radiation monitoring program is intended to provide assurance that there has been no infringement of Australian public health standards due to the release of radioactive material from the waste control and retention systems of a visiting NPW.

6. The relevant Australian public health standards are those endorsed by the National Health and Medical Research Council in 1980 (**Recommended Radiation Protection Standards for Individuals Exposed to Ionising Radiation**, AGPS 1981). These standards relate to permissible ionising radiation doses received by individuals from both external radiation sources and from the intake of radionuclides in air, water and foodstuffs.

7. **Internal radiation.** Internal radiation exposure of individuals could follow consumption of seafoods should these become contaminated with radioactive waste material. Accordingly, a marine environmental monitoring program is implemented to take samples of the surface layer of the bottom sediment and selected seafoods or seaweed (where available), from the vicinity of approved berths and anchorages.

8. These samples are analysed for evidence of cobalt-60 and other artificial gamma ray emitting radionuclides known to characterise the radioactive waste likely to be held in an NPW.

9. **External radiation.** When an NPW is at an alongside berth, gamma radiation surveys are undertaken at the wharf in those areas in the vicinity of the vessel designated as free for access by the public or by port employees. Surveys are made initially on the vessel's arrival and periodically thereafter for the duration of the visit, using portable meters capable of measuring ionising radiation dose rates down to 0.1 uSv/hr (1 uSv/hr is 10–6 Sv/hr).

10. **Thermoluminescent dosemeters.** In order to record the accumulated ionising radiation doses that might be experienced in the port environs following an accidental release of airborne radioactivity, a number of thermoluminescent dosemeters (TLDs) are exposed at selected locations. The TLDs remain in position during the period that an NPW is in port or, in the event of an accident, would remain in position until the termination of the accident. Control TLDs are exposed at the Australian Radiation Laboratory in Melbourne and also in the port being visited, but remote from the NPW to provide a comparison with the TLDs exposed in the field. Field and control TLDs are returned to the Australian Radiation Laboratory for measurement.

Direct Radiation Monitoring

11. **Early warning detection.** In order to provide early warning of an NPW reactor malfunction at an alongside berth, fixed radiation detectors are located in the vicinity of the vessel to provide continuous monitoring of gamma radiation levels. The detectors cover the range 0.01 mSv/h to 0.1 Sv/h with an audible alarm set to trigger at a level of 1.0 mSv/h. A significant release of radioactivity within the vessel from the reactor would be detected and initiate an alarm.

PROGRAM IMPLEMENTATION

The Monitoring Program

12. The monitoring program is undertaken by groups made up from the Australian Nuclear Science and Technical Organisation (ANSTO), the health and environmental authorities of the host State and the Royal Australian Navy (RAN). The composition of the groups varies in different ports except that the Leader of the Radiation Monitoring Group is always a radiation protection officer of the ANSTO.

13. The marine environmental monitoring program is a joint undertaking by the Commonwealth Department of Community Services and Health and either the State concerned, or where the berth is in a naval dockyard, the RAN. The collection of samples of sediment and seafood or seaweed is carried out by State authorities or by the RAN, nominally at quarterly* intervals at approved berths and anchorages. Samples are also taken prior to and immediately after each visit. The analysis and measurement of samples is undertaken by the Department of Health at the Australian Radiation Laboratory. Details of the measurement method and detection capability are presented in Appendix 1.

14. The routine sampling program may be discontinued at NPW berths being visited infrequently and where an adequate database has been established. When an NPW visits such a berth, samples are taken prior to and immediately after the visit and a further set of samples 3 months later.

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* In practice, quarterly generally means 14 days either side of the end of the quarter. Should pre- or post-visit samples fall within two weeks of the due date for routine sampling, then the same set of samples will suffice for the routine and either pre- or post-visit samples. Authorities occasionally have difficulty in obtaining samples within these timescales.

Contingency Arrangements

15. Port safety organisations have been established at all ports approved for NPW visits and arrangements made so that in the event of a reactor accident they would be activated immediately. Simultaneously, radiation surveys would be initiated by Commonwealth officers in order to identify any radiation hazards. Prior to each visit, the Port Safety Organisation is brought to a state of readiness and briefings conducted to familiarise key participants with the operational procedures and the tasks required of them in the event of an accident. Normally, an exercise is conducted during an NPW visit and involves key members of the Port Safety Organisation.

PART II - NUCLEAR POWERED WARSHIP VISITS IN 1986

HMAS STIRLING, GARDEN ISLAND, WESTERN AUSTRALIA

1. Three nuclear powered warships of the US Navy visited HMAS STIRLING, Garden Island, Western Australia during 1986, as listed in Table 1. In each case the vessels berthed at the Submarine Wharf.

Radiation Monitoring

2. Throughout each visit gamma radiation levels were monitored in the vicinity of the vessel using fixed radiation detectors. Operation of the detectors commenced before each vessel's arrival and continued until its departure. Measurements were displayed and recorded on equipment located in the Naval Police Gate House which is manned continuously. In addition, measurements of gamma radiation levels were taken daily using hand held dose-rate meters in areas around the vessel which were accessible to personnel on the base.

Results

3. The gamma radiation dose rates measured by both fixed and portable monitoring equipment for all NPW visits to HMAS STIRLING were in the range 0.05 to 0.15 uSv/h.

4. Thermoluminescent dosemeters (TLDs) were exposed at 5 selected locations (2 per location) for each visit as shown in Figure 2. Control TLDs were held in Perth and at the Australian Radiation Laboratory. The range of dose rate measurements from TLDs for the three visits were as follows:

	dose rate range (uSv/h)
Field location	0.07 to 0.12
Perth controls	0.07 to 0.10
ARL controls	0.04 to 0.06

5. Samples of mussels and bottom sediment were collected from the vicinity of the Escort and Submarine Wharves at HMAS STIRLING on nine occasions during the year as indicated at Figure 1. Twenty-six samples were collected in total, all of which were returned to the Australian Radiation Laboratory. Analysis showed no evidence of any radionuclide characteristic of the radioactive waste associated with NPW operations.

Contingency Arrangements

6. The WA Port Safety Organisation was placed on standby for each visit and briefings held for key personnel. The State Emergency Services Headquarters at Belmont, which was designated as the Emergency Operations Centre, was manned continuously for the period of each visit.

GAGE ROADS, FREMANTLE, WESTERN AUSTRALIA

7. Two nuclear powered aircraft carriers of the US Navy visited Fremantle, Western Australia during 1986, as indicated in Table 1. The vessels anchored at approved, designated locations in Gage Roads.

Radiation Monitoring

8. Fixed gamma radiation monitoring equipment was located in the Fremantle, Port Authority Tower. Operation commenced prior to the vessel's arrival and continued throughout the visit. Measurements were displayed and recorded on equipment within the Tower which was manned on a 24 hour basis.

9. Gamma dose rate levels were measured using hand held instruments at positions on the shore line daily during the visit and TLDs were exposed at 5 selected locations (2 per location) as shown in Figure 2. Control TLDs were held in Perth and at the Australian Radiation Laboratory for analysis.

Results

10. The on-shore gamma radiation dose rates measured during the visits were within the range 0.10 to 0.17 uSv/h.

11. The range of dose rate measurements from TLDs for both visits were as follows:

	dose rate range (uSv/h)
Field location	0.06 to 0.13
Perth controls	0.07 to 0.13
ARL controls	0.04 to 0.08

12. A total of 15 samples of seaweed and bottom sediment collected from the foreshore were analysed at the Australian Radiation Laboratory. None of the samples showed evidence of any radionuclides characteristic of the radioactive waste associated with NPW operations.

Contingency Arrangements

13. The WA Port Safety Organisation was placed on standby throughout the visit. The State Emergency Services Headquarters at Belmont functioned as the Emergency Operations Centre and was manned continuously for the period of the visit.

TRAINING

14. A refresher course was conducted in January by ANSTO staff for an RAN Petty Officer at HMAS STIRLING relating to specific monitoring equipment, and at the request of the Commanding Officer, an ANSTO health physicist gave a talk on radiation safety to staff at the base.

15. In December, ANSTO health physics staff provided a training course for State Radiation Officers who had not previously participated as radiation monitoring technicians. The training included formal lectures and exercises to provide familiarity with the emergency radiation monitoring equipment.

CONCLUSIONS

16. The program of radiation monitoring and marine environmental sampling implemented for visiting NPWs during 1986 was consistent with the Commonwealth Government's requirements.

17. There was no indication of any infringement of Australian public health standards. Radiation monitoring did not detect any release of radioactive material, nor did any radiation measurement indicate any value in excess of background levels of ionising radiation either during or subsequent to these visits.

TABLE 1 - NUCLEAR POWERED WARSHIP VISITS - 1986

VESSEL	TYPE	PORT	DATES
USS TAUTOG	Submarine	HMAS STIRLING	Jan 29 - Feb 4
USS ENTERPRISE	Aircraft Carrier	Gage Roads, WA	Jul 18 - 24
USS TRUXTUN	Guided Missile Cruiser	HMAS STIRLING	Jul 18 - 24
USS ARKANSAS	Guided Missile Cruiser	HMAS STIRLING	Jul 18 - 24
USS CARL VINSEN	Aircraft Carrier	Gage Roads, WA	Dec 19 - 27

APPENDIX I

MARINE ENVIRONMENTAL MONITORING

Measurement Method

1. Each sample is measured for 10,000 seconds, in a standard geometry, in a low background gamma-ray spectrometer with Ge (Li) detector. Each gamma-ray spectrum is scrutinised over the energy range of 50 to 1500 keV for evidence of cobalt-60 and other artificial gamma-ray emitting radionuclides.

Detection Capability

2. The measurement method used has sufficient sensitivity to detect concentrations of gamma-ray emitting radionuclides in shellfish which, based upon typical intakes of shellfish, would result in no more than one percent of the annual limits for members of the public as given in the 1980 recommendations of the Australian National Health and Medical Research Council **Recommended Radiation Protection Standards for Individuals Exposed to Ionising Radiation** (AGPS, 1981).

3. For surface layer of bottom sediments, the measurement method used has sufficient sensitivity to detect artificial gamma-ray emitting radionuclides at concentrations at least as low as 40 millibecquerels per gram of sediment.

RADIATION MONITORING AT

AUSTRALIAN PORTS VISITED BY

NUCLEAR POWERED WARSHIPS

PART 1 - REQUIREMENTS

PART 2 - ARRANGEMENTS AND PROCEDURES

Issued by the Department of Defence

Revision 1
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RADIATION MONITORING AT AUSTRALIAN PORTS VISITED BY NUCLEAR POWERED WARSHIPS

CONTENTS

FOREWORD

1. The Commonwealth Government has determined Conditions of Entry which are to be met when nuclear powered warships (NPWs) visit Australian ports. These are:

a. Visits will be for purposes such as crew rest and recreation, and not for fuel handling or repairs to reactor plant (necessitating breach of reactor containment).

b. Visits will be subject to satisfactory arrangements covering liability and indemnity, and to provision of adequate assurances relating to the operation and safety of the warships while they are in Australian waters.

c. Movement of vessels must take place during daylight hours under conditions where visibility is not less than three-quarters of a nautical mile.

d. Navigational controls on other shipping will be applied during the time that NPWs are entering and leaving port.

e. There must be a capability to remove the vessel, either under its own power or under tow, to a designated safe anchorage or a designated distance to sea, within the time frame specified for the particular berth or anchorage, and in any case within 24 hours, if an incident should occur.

f. An operating safety organisation, competent to conduct a suitable radiation monitoring program and able to initiate actions and provide services necessary to safeguard the public in the event of a release of radioactivity following an accident, must exist for the port being visited.

2. This document, at Part 1, details the requirements of a radiation monitoring program as required by Condition of Entry at subparagraph 1f above. The fundamental arrangements and procedures for implementing the program, presented at Part 2, are the basis of detailed arrangements which are in place at ports currently approved for NPW visits.

3. The first edition of this document was published in September 1979 under the title 'Guidelines for Environmental Radiation Monitoring During Visits of Nuclear Powered Warships to Australian Ports'. This edition contains a number of editorial changes. The Objectives and Principles of the first edition are now presented as Requirements. The Guidelines of the first edition have been amended in the light of experience gained in their application during some 80 NPW visits made to Australian ports since such visits were resumed in 1976. The Guidelines are now set out as Arrangements and Procedures.

4. The 'Working Guidelines for Emergency Reference Levels' formerly at Annex B, and certain technical data of a detailed nature, have been omitted from the revision and are presented in the 'Radiation Monitoring Handbook for Visits by Nuclear Powered Warships to Australian Ports' published by the Australian Atomic Energy Commission. Details of Emergency Planning Zones around NPW berths in Australian ports are included as an Annex to this document for reference purposes.

5. This document will be reviewed and updated, as necessary, in the light of further experience. Proposed amendments to the Requirements set out in Part 1 of this document require endorsement at Ministerial level. Amendments to the Arrangements and Procedures set out in Part 2, subject to their being consistent with the Requirements may be made under the authority of the Chairman of the Visiting Ships Panel (Nuclear).

PART 1

THE REQUIREMENTS FOR RADIATION MONITORING AT AUSTRALIAN PORTS VISITED BY NUCLEAR POWERED WARSHIPS

Introduction

1. A Condition of Entry of visits by nuclear powered warships (NPWs) to Australian ports is that there be the capability to car y out radiation monitoring in the port being visited. The objectives are:

a. to determine whether any radioactive material has been released and whether radiation levels have increased above normal background;

b. to determine the nature and extent of any release;

c. to assess levels of radiation and radioactive contamination in the environment around the ship;

d. to assess the magnitude and nature of the hazards arising from an accident; and

e. to determine when a release has terminated and when affected areas have returned to normal.

2. To meet these objectives, detailed radiation monitoring programs are developed for each Australian port visited by NPWs. Programs, which are included in the relevant Port Safety Scheme, are based upon the radiation monitoring requirements which are set out in Part 1 of this document for both routine and accident situations.

Routine Radiation Monitoring

3. Experience has shown that the release of radioactive material or the emission of ionising radiation from an NPW in port during a normal ship visit are extremely unlikely events. However, routine radiation monitoring is required in order to detect any change in the level of background radioactivity and contamination in the port environment as a consequence of such visits. Objective (a) requires that means be provided to detect whether any radioactivity has been discharged or accidentally released from an NPW in an Australian port, whilst objectives (b) and (c) require that means be provided to determine the nature and extent of any such release or emission and to assess the levels of radiation and contamination in affected areas. Requirements are set out for monitoring in relation to the emission of ionising radiation and for the release of solid or liquid radioactive waste. The release of significant amounts of radioactive material in a gaseous form is only considered to be feasible as a consequence of a reactor accident.

4. **On Shore Monitoring.** External radiation levels in the vicinity of an NPW at an alongside berth are to be checked at intervals by radiation surveys of areas designated as free for public access. Arrangements and procedures for the implementation of this requirement are given in Part 2, paragraphs 11-12.

5. **Marine Monitoring.** The release of radioactive waste material in solid or liquid form could give rise to the contamination of seafood in the vicinity, and internal radiation exposure of people who consume contaminated seafood could follow. Accordingly, a program of marine environmental monitoring is required to keep under surveillance radiation levels in the marine environment. Samples are to be taken of:

a. the surface layer of bottom sediment from the vicinity of the berth or anchorage; and

b. selected seafood taken from the vicinity of the berth or anchorage;

6. Samples are to be analysed for cobalt-60 and any other radionuclide known to characterise the radioactive waste likely to be held in an NPW. Arrangements and procedures for the implementation of this requirement are given in Part 2, paragraphs 15-20.

7. **Radiation Protection Standards.** The Australian public health standards that are relevant to radiation exposure of members of the public from the sources identified above are the recommendations of the National Health and Medical Research Council's 'Recommended Radiation Protection Standards for Individuals Exposed to Ionising Radiation', as amended from time to time.

Radiation Monitoring Related To A Reactor Accident

8. **Accident Notification and Detection.** The Government of the United States has provided an assurance that:

> 'The appropriate authorities of the host government will be notified immediately in the event of an accident involving the reactor of the warship during a port visit.'

Standing contingency response arrangements at Australian ports used by NPWs require the immediate evacuation of Emergency Planning Zone 1 (see Annex A) upon notification of a reactor accident. At alongside berths, Zone 1 could include dockside buildings and facilities and a significant number of workers could be present during working hours. Accordingly, so that timely remedial action will be possible within Zone 1, an early warning accident detection facility is provided. The facility is to keep the NPW under surveillance for increases in background levels of gamma radiation that could provide an indication of a reactor accident. Arrangements and procedures for the implementation of radiation monitoring related to a reactor accident are outlined in Part 2, paragraphs 21-32.

9. **Immediate Post-Accident Monitoring.** Radiation monitoring surveys are to be initiated immediately on detection of a high background gamma radiation level by the early warning facility or on the receipt of advice that an accident has occured. The objectives of the surveys are to determine if any radioactive material has been released, to identify any hazards to health, and to provide information which will assist in evaluating the severity of the accident and in assessing the need for countermeasures as required by objective (d).

10. To ensure that results of radiation monitoring surveys can be available in a timescale to enable any necessary countermeasures to be implemented, the capability to carry out immediate post-accident monitoring is required to be maintained in a port throughout NPW visits.

11. **Longer Term Post-Accident Monitoring.** Objective (e) requires that more extensive environmental radiation monitoring of affected areas be undertaken following the immediate post-accident monitoring phase. This activity could possibly continue over a period of days. Additional personnel and equipment and other resources such as laboratory facilities would need to be enlisted for these purposes. The necessary arrangements are to be made in advance.

12. **Radiation Protection Standards.** The emergency reference levels for major radiation accidents recommended by the National Health and Medical Research Council in 'Recommended Radiation Protection Standards for Individuals Exposed to Ionising Radiation', as amended from time to time, are to be used as the basis for the determination of appropriate countermeasures against radiation exposure following an accident.

PART 2

ARRANGEMENTS AND PROCEDURES

General

1. Radiation monitoring programs are developed for each individual Australian port visited by NPWs and incorporate the fundamental arrangements and procedures set out below. Full details of such programs are included in the relevant Port Safety Scheme. The arrangements and procedures presented here relate to radiation monitoring of routine and accident situations and provide for the allocation of certain key responsibilities in a monitoring program. Also included is an outline of procedures whereby Commonwealth radiation protection officers, undertaking routine monitoring at a port, are able to alert the Port Safety Organisation in the event of a release of radioactive material.

2. **Radiation Monitoring Handbook.** The techniques, practices and procedures of radiation monitoring for NPW visits, the correlation of measured radiation levels with radiological risks and protective measures, together with working guidelines relating to the emergency reference levels recommended by the national Health and Medical Research Council are set out in the Radiation Monitoring Handbook. This Handbook is made available as a reference document to all Commonwealth, and State/Territory radiation protection officers participating in radiation monitoring for NPW visits.

3. **Radiation Monitoring Group.** A Radiation Monitoring Group (RMG) is collocated at ports during each NPW visit to carry out routine and, in the event of an accident, immediate post-accident radiation monitoring. The Commonwealth, through the Australian Atomic Energy Commission (AAEC), ensures that an appropriately qualified officer is available for each NPW visit to be Group Leader. For routine monitoring the RMG is staffed by the designated Group Leader and a second Commonwealth officer, each provided with a vehicle and radiation monitoring equipment to function as a mobile monitoring unit. In an emergency, additional mobile monitoring units will be made operational, staffed by State/Territory radiation protection officers, under the control of the Leader, RMG.

4. **State/Territory Radiation Officer.** A State/Territory Radiation Officer (SRO/TRO) is nominated for each NPW visit and is responsible for advising authorities of the host State/Territory on all public health aspects of radiation safety arising from NPW visits. The SRO/TRO is a senior professional health physicist nominated by the host State/Terriroty.

5. In the event of a radiation accident, the SRO/TRO is specifically responsible for advising the Port Safety Organisation:

a. on hazards to the health of members of the public,

b. on the need to implement countermeasures, and

c. when normal activities may be resumed in affected areas.

6. In conjunction with the Leader, RMG the SRO/TRO is jointly responsible for:

a. designating the pattern of post-accident radiation monitoring conducted by the RMG,

b. assessing the specific needs for ongoing radiation monitoring, and

c. analysis of radiation monitoring results.

7. **Pre-Visit Preparation and Standby Arrangements.** Those items of radiation monitoring equipment required for routine monitoring and for immediate post-accident monitoring, are made available at ports during NPW visits by the AAEC. The equipment is held in the custody of the Leader, RMG. Support operations and communications facilities are a State/Terrirory responsibility.

8. Before each NPW visit the RMG is brought to operational readiness. The Leader, RMG is responsible for control of:

a. pre-visit exercising/briefing of the RMG,

b. readiness and functional status of all monitoring equipment,

c. communication facilities for the RMG, and

d. transport facilities for the RMG.

9. The State/Territory members of the RMG will then revert to standby for the period of the visit or until called out. Commonwealth members of the RMG will implement the routine radiation monitoring procedures and remain on call throughout the visit.

10. Pre-visit arrangements are made for the provision of meteorological data, including local wind speed and direction, to assist in estimating the extent and magnitude of the effects of any release of airborne radioactivity.

Routine Radiation Monitoring

11. **On Shore Monitoring - Gamma Radiation Surveys.** When NPWs are at alongside berths, background gamma radiation levels at the berth are checked by radiation surveys initially on the vessel's arrival and once daily thereafter. The surveys are undertaken in those areas in the vicinity of the NPW designated as free for public access.

12. Commonwealth members of the RMG make the surveys in accordance with the instructions set out in the Radiation Monitoring Handbook and the results are examined by the Leader, RMG who is to draw the attention of the SRO/TRO to any increase in established background radiation levels.

13. **Thermoluminescent Dosemeters.** A number of thermoluminescent dosemeters (TLDs) are exposed at selected locations in a port throughout each NPW visit so that, in the event of a reactor accident, measurements of radiation levels at those locations would be available for post-accident analysis purposes.

14. The provision and measurement of TLDs is the responsiblity of the Australian Radiation Laboratory. The number and location of TLDs for individual ports are determined jointly by representatives of the Commonwealth and the appropriate State/Territory authority.

15. **Marine Surveys.** Marine environmental monitoring programs are required to sample sediment and seafood from the vicinity of NPW berths and anchorages. The programs are cooperative arrangements between the Commonwealth and the host State/Territory.

16. Samples are collected by State/Territory authorities, or by the RAN where berths are at naval bases, and analysed at the Australian Radiation Laboratory. Measurements are made speparately on sediment and seafood and attention is to be drawn to any result indicating an increase in established background levels. More extensive surveys of the marine environment would then need to be undertaken to investigate the possible movement of radioactive contaminants to the shoreline or into other marine food chains. Results of routine measurement are forwarded by the Commonwealth to appropriate State/Territory authorities when available.

17. **Alongside Berths.** At alongside berths, quarterly samplings are made with an allowed flexibility of two weeks each side of the due sampling date. If an NPW visits a berth, an additional full set of samples are taken prior to and following the visit. Should pre-visit or post-visit sampling be required within two weeks of the due date for routine quarterly sampling, then either the pre-visit or post-visit sampling will suffice for the routine quarterly sampling.

18. The quarterly sampling program at an approved berth that receives only infrequent NPW visits may be discontinued provided that:

a. a quarterly sampling program has been implemented for a period of not less than two years, and

b. State/Territory and Commonwealth authorities agree that a reliable base-line of radioactivity has been established.

19. Where a berth at which quarterly sampling has been discontinued is subsequently to be used for a visit by an NPW, a set of samples are to be taken prior to and following the visit, and another set of samples three months later. Provided the samples reveal no increase in established background levels of radioactivity, then quarterly sampling may again be discontinued.

20. **Anchorages.** For anchorages, sampling takes place at points on the shoreline designated by State/Territory authorities as being those at which any contamintion released at the anchorage would most likely be deposited. Samples are collected prior to and following a visit, and three months later, within an allowed flexibility of two weeks each side of the due sampling date.

Radiation Monitoring Related to a Reactor Accident

21. Early Warning Facility. A facility to provide early warning of a reactor accident is provided based upon the detection of gamma radiation that would be emitted from the NPW as a consequence of the accident.

22. The early warning facility:

a. is capable of continuous unmanned operation,

b. has its detectors located with clear line of sight to the NPW, and

c. provides visual and audible alarms upon detection of a sustained increase in gamma radiation levels.

23. Signals from the detectors are relayed to a chart recorder with a pre-set alarm facility located at a suitable Port Control Office or Police Gate House, or at the Emergency Operations Centre of the Port Safety Organisation.

24. Selection of a suitable site for the detectors of the early warning facility and a location for the chart recorder is made after consultation between State/Territory and Commonwealth officers. The installation of the facility is undertaken by the Commonwealth with State/Territory assistance as required.

25. **Operation of the Early Warning Facility.** The chart recorder of the early warning facility will provide an audible and visual alarm signal on detection of a sustained high gamma radiation level. Guidance on the appropriate alarm level is set out in the Radiation Monitoring Handbook. Commonwealth or State/Territory officers are in continuous attendance throughout each NPW visit to respond to an alarm signal in accordance with predetermined procedures. These procedures, which are developed for each port from the general principles set out in paragraphs 26-27, are detailed in the relevant Port Safety Plan.

26. **Procedures Following an Alarm.** The Leader, RMG and the Duty Officer of the Emergency Operations Centre will be notified immediately of an indication of high radiation level and will react as follows:

a. The Leader, RMG will immediately investigate whether the indication is genuine. If so, the Emergency Operations Centre will be advised of a confirmed alarm and radiation surveys commenced as outlined in paragraphs 28-30. If the alarm signal is not confirmed the non-confirmation will be recorded and, if due to an instrument fault, the fault remedied immediately.

b. The Duty Officer, Emergency Operations Centre, will immediately, through established channels, contact the NPW to seek confirmation of an accident.

27. Upon confirmation of an alarm to the Duty Officer, either from the NPW or from the Leader, RMG, the actions set out in Port Safety Plans for the immediate evacuation of Emergency Planning Zone 1 will be initiated and the Port Safety Organisation activated.

28. Immediate Post-Accident Monitoring. Upon confirmation of an alarm, radiation surveys will be commenced by the Commonwealth members of the RMG. The first priorities are:

a. gamma radiation measurements to determine the magnitude andF extent of any external radiation hazards due to direct radiation from the NPW;

b. gamma radiation measurements and air sampling to determine if a release of radioactive material has occurred; and

c. air sampling to determine airborne concentrations of critical radionuclides and to estimate inhalation hazards to members of the population.

29. The Leader, RMG will direct the radiation surveys as outlined above, initially in a direction downwind from the NPW. In conjunction with the SRO/TRO, he will interpret the results and determine the need for further surveys.

30. Arrangements are made for the decontamination of persons evacuated from Zone 1, as necessary. Monitoring is also carried out for:

a. surface contamination in areas which could be affected by fission products,

b. contamination of milk and other foodstuffs, and

c. contamination of the marine environment around the NPW.

31. Longer Term Post-Accident Monitoring. Following the immediate post-accident radiation monitoring period, more extensive environmental radiation monitoring will be undertaken to:

a. determine the extent of any decontamination needed,

b. monitor foodstuffs that may have been affected,

c. provide assurances that evacuated areas can be reoccupied, and

d. provide assurances that normal activity may be resumed in affected areas.

32. Substantial resources of staff and equipment may be needed for this purpose, but the requirement is less urgent than the immediate post-accident monitoring. Therefore, these resources are derived from other centres, including those remote from the port being visited. Organisations that are required to contribute this assistance are informed beforehand.

Countermeasures

33. The need for countermeasures outside of Zone 1 will be determined from analysis of the radiation field measurements undertaken by the RMG. The SRO/TRO, in consultation with the Leader, RMG, is responsible for providing technical advice on the need for countermeasures. Information on the recommended intervention levels at which countermeasures are to be considered or implemented are provided in the Radiation Monitoring Handbook. Information on the implementation of countermeasures is provided in Port Safety Plans.

Support Facilities

34. **Communications.** Radio communication facilities and equipment for radiation protection officers of the RMG are made available by the appropriate State/Territory authority.

35. **Road Transport.** Vehicles for use as mobile monitoring units throughout NPW visits are made available by the appropriate State/Territory.

Equipment

36. All radiation monitoring equipment is provided by the Commonwealth. It is retained by the Australian Atomic Energy Commission and properly maintained and calibrated. Equipment required for an NPW visit is made available at the port, checked and made operational as part of the preparation and standby arrangements. Equipment lists are set out in the Radiation Monitoring Handbook. Arrangements are made by the appropriate State/Territory authority for secure storage facilities to accommodate equipment for the RMG.

ANNEX A

EMERGENCY PLANNING ZONES

(REFERENCE: OPSMAN 1)

1. Emergency Planning Zones (EPZs) are designated around NPW berths and anchorages for planning purposes to assist in the identification of areas where hazards might arise and to ensure that appropriate protective actions can be taken promptly and effectively in the event of an accident:

a. **Zone 1** is an area close to the NPW within which protective measures will be implemented automatically upon notification of a reactor accident.

b. **Zone 2** represents the area at risk from inhalation hazards and includes Zone 1. The Zone boundary represents the limit at which it may be necessary to implement protective measures to prevent radiation doses from inhalation from exceeding the individual dose criteria.

c. **Zone 3** represents the area at risk with respect to ingestion hazards, ie foodstuffs, milk, water and agricultural contamination, and includes Zones 1 and 2.

2. The boundaries of Zones 2 and 3 will vary according to the severity of the accident and the prevailing meteorological conditions, and in practice will be determined by measurements of radiation and contamination levels.

3. Based upon the Reference Accident, the estimated maximum EPZ boundaries of berths and anchorages when used by NPWs up to 100 MW reactor power rating are:

a. **Zone 1** – 600 metres,

b. **Zone 2** – 2.2 km,

c. **Zone 3** – several kilometres.

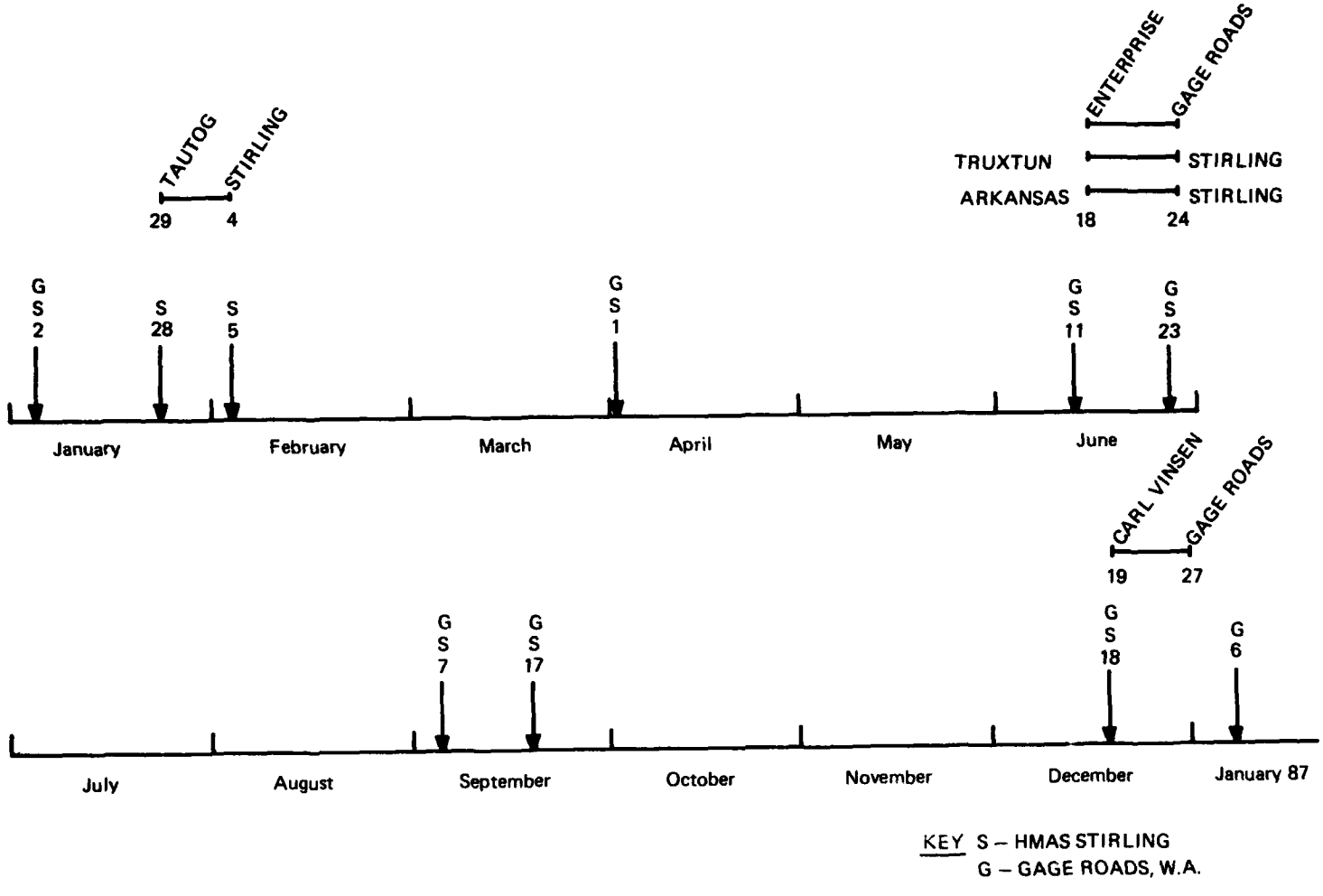
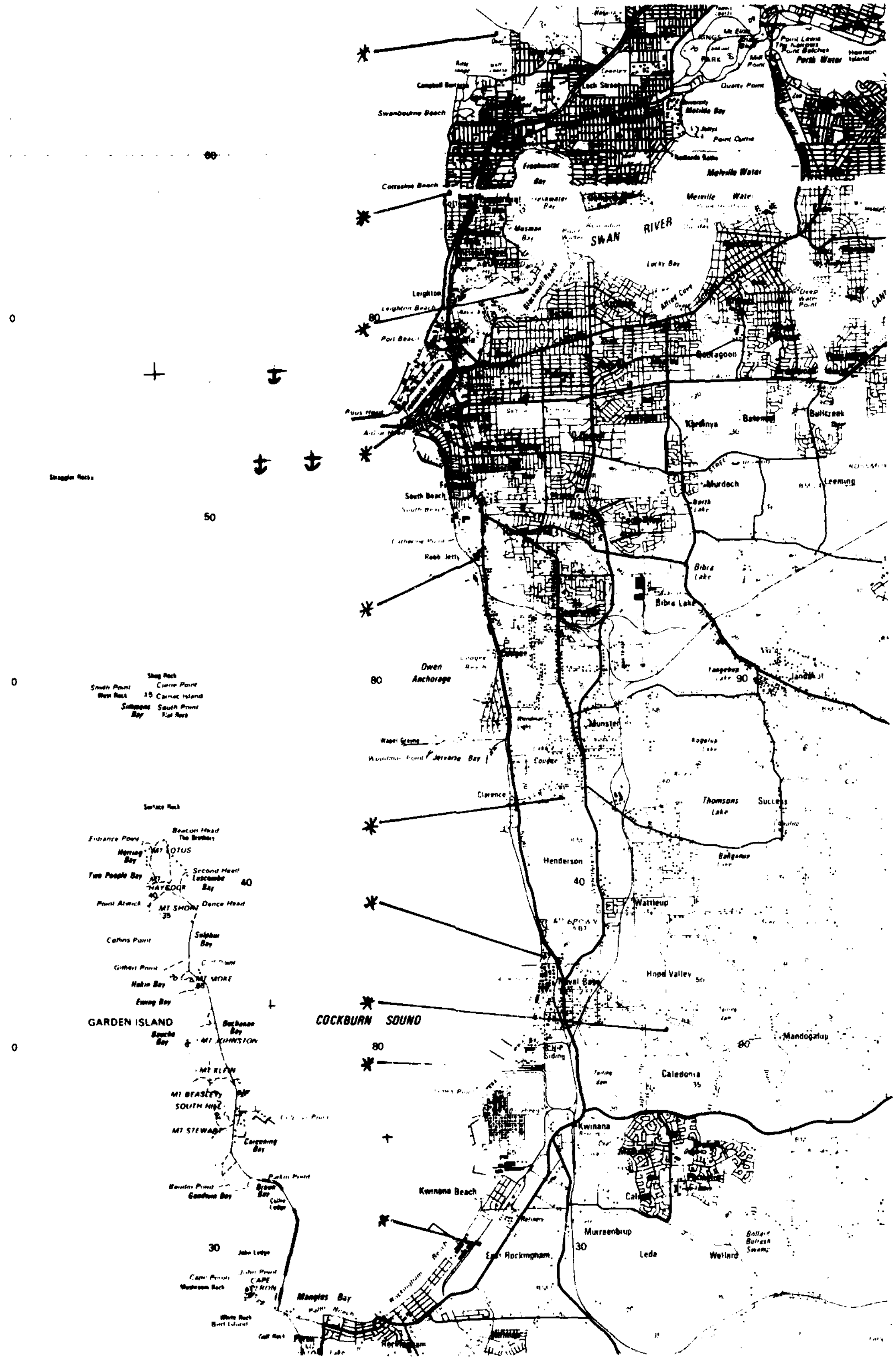


FIGURE 1 – MARINE ENVIRONMENTAL SAMPLING DATES, 1986



Swanbourne Beach
Cottesloe Beach
Freshwater Bay
Mosman Bay
SWAN RIVER
Melville Water
Point Walter
Matilda Bay
Perth Water
Quarry Point
Point Resolution
Lucky Bay
Alfred Cove
Leighton
Leighton Beach
Port Beach
Booragoon
Kardinya
Bateman
Bullcreek
Murdoch
Leeming
South Beach
Robb Jetty
Bibra Lake
Owen Anchorage
Munster
Jervoise Bay
Woodman Point
Clarence
Thomsons Lake
Success
Henderson
Wattleup
Naval Base
Hope Valley
Mandogalup
Caledonia
Kwinana
Kwinana Beach
Murreenbrup
Leda
Wellard
East Rockingham
Mangles Bay
COCKBURN SOUND
GARDEN ISLAND
Carnac Island
Buchanan Bay
Cockburn Sound Buchanan Bay
Two People Bay
Point Atwick
Collins Point
Gilbert Point
Sulphur Bay
Beacon Head
Entrance Point
Second Head
Dance Head
Surface Rock
Goodman Bay
Colpoys Point
Parkin Point
Cape Peron
John Point
White Rock
Bird Island
Gull Rock
Straggler Rocks